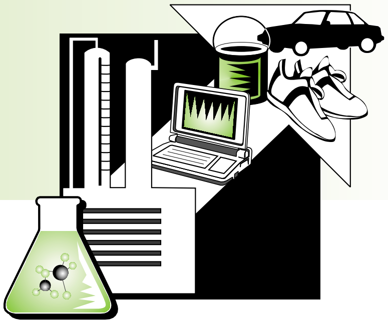
CHEMICALS

Project Fact Sheet



Advanced Membrane Materials for Reducing Energy Consumption in p-Xylene Separation

Benefits

- Energy savings of about 105 trillion Btu annually by 2020 (assumes increase in demand of 7 percent)
- Reduced capital expenditures in the chemical industry
- Reduced dependence on imported fossil fuels by the United States

Applications

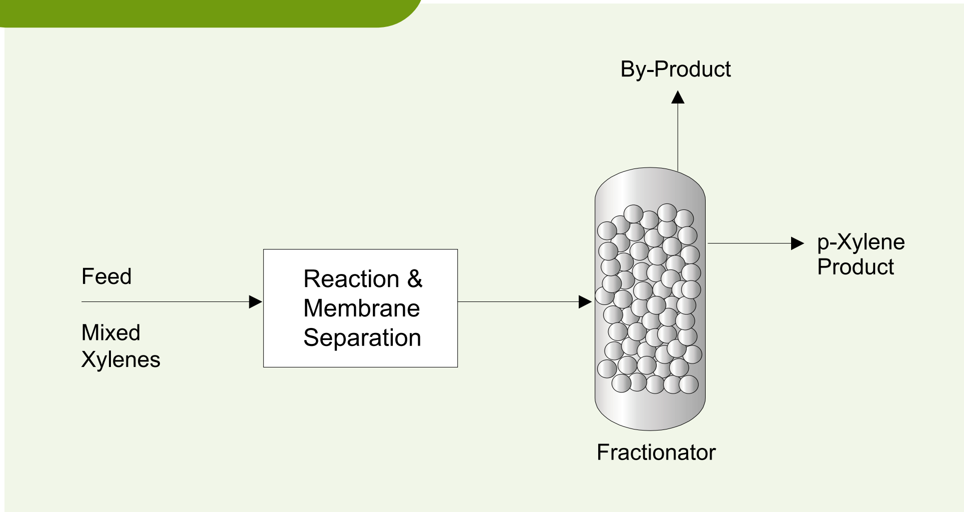
A successful membrane technology will find wide application in producing PTA, the raw material for producing polyester and poly plastics. The membrane can also be adapted to carry out other separations in the chemical and refining industries.

Thin-film membrane will revolutionize plastics production and reduce petroleum imports

The chemical industry has the opportunity to achieve a significant reduction in energy use in the production of polyester and polyethylene terephthalate (poly) plastics. The raw material for these products is purified terephthalic acid (PTA), which is currently derived from petroleum by separating its precursor, *para*-xylene (pX), from other xylene isomers through a very energy-intensive process of distillation, adsorption, and cryogenic crystallization.

Researchers are working to develop an inorganic membrane with improved properties that will separate pX more efficiently than by conventional methods. Membrane separation of pX would require over 75 percent less energy than current technology. As production of pX is a significant portion of the U.S. chemical industry's annual output, this could result in substantial energy savings and reduction in carbon emissions.

Membrane Process for p-Xylene



A microporous inorganic membrane separates mixed xylenes more efficiently than current methods.

Project Description

Goal: To develop materials that will separate C8 (compounds containing 8 carbon atoms) aromatic mixtures, design a pilot plant to separate *para*-xylene (pX) from a mixture of xylenes, and apply the process to other commercial opportunities in the chemicals and petroleum refining industries.

There are three phases to this 3 year project: (1) identification of membranes with the potential for separating pX from a mixture of xylenes; (2) optimization of deposition techniques for the best zeolite candidates identified, and demonstration of the economic feasibility of the membranes at the bench scale; and (3) design of a pilot plant module for membrane synthesis, and transfer of the technology to Amoco for commercialization.

Computer modeling will be used to design novel, ultra-thin materials that will achieve the maximum separation of xylene isomers. A film thickness of less than 1 micron is required to achieve a membrane with the desired characteristics. Primary technical barriers to this work are the precise control of the pore structure and the adsorption properties of the materials. The membranes should have four characteristics: uniform pore size, a shape selectivity based on the tailored pore size, chemical and mechanical stability, and high-temperature stability.

Progress and Milestones

- Studies have indicated that an MFI/sol-gel film will separate pX from a stream containing a mixture of isomers.
- Modeling has shown that a membrane can be packed with catalyst in order to separate pX as it is formed.
- Sandia Laboratory has obtained positive results in preliminary studies of three different methods for synthesizing composite MFI/sol-gel membranes.
- The 1st-year milestone is identifying at least one candidate with the potential for separating pX from a mixed stream of xylenes.
- The 2nd-year milestone is demonstrating (at the bench scale) the economic feasibility of using reproducible zeolite membranes for separations.
- The 3rd-year milestone is completing the design of a commercially scalable pilot-plant module of a zeolite membrane.

Project Partners

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Coors Technical Ceramics Company
Oak Ridge, TN

Sandia National Laboratories
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